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NPIC/P&DS/D/6-736
20 January 1966

MEMORANDUM FOR: Director, National Photographic Interpretation Center

SUBJECT: Research and Development Project Approval Request for Overrun on P.I. Performance and Techniques Study

REFERENCE: Chief, Administrative Staff, O/DDI, Memorandum dated 4 February 1964: Approval of Research and Development Activities

1. In accordance with permission of the Executive Director, NPIC, the attached R&D Catalog Form is forwarded for approval prior to referral to the TDB, since the overrun costs less than twenty per cent of the original contract price. Concurrence for this action has been obtained through verbal conversations between [redacted] I&D, on 19 January 1966.

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2. In accordance with the authority delegated in paragraph 3. of the reference, it is requested that the overrun for the PI Performance and Techniques Study be approved. The estimated cost of this overrun is [redacted] and is to be charged against FY-64 funds.

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[redacted]

Colonel, USAF
Assistant for Plans and Development, NPIC

NGA review(s) completed.

25X1

APPRO[redacted]

ARTHUR C. LUNDAHL
Director, NPIC

24 JAN 1966
Date

Attachment: R&D Catalog Form

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(When Filled In)

REVISED # 09711-4

R & D CATALOG FORM

DATE: 18 January 1966

1. PROJECT TITLE/CODE NAME	2. SHORT PROJECT DESCRIPTION
P.I. Performance and Techniques Study (Overrun)	This project is designed to acquire objective measurements of photo-interpreter performance as they are related to image variables and to interpretation procedures.

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3. CONTRACTOR NAME	4. LOCATION OF CONTRACTOR

5. CLASS OF CONTRACTOR	6. TYPE OF CONTRACT
Manufacturer	CPFF

7. FUNDS	8. REQUISITION NO.	9. BUDGET PROJECT NO.
FY 1965	N/A	NP-HF-1 (Former NP-S-28)
FY 1964		
FY 19 $		

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10. EFFECTIVE CONTRACT DATE (Begin - end)	11. SECURITY CLASS.
Time period to be funded by FY-1965 overrun funds. 25 March 1966 - June 1966	A. A. - Confidential T. - Unclassified W. - Top Secret

12. RESPONSIBLE DIRECTORATE/OFFICE/PROJECT OFFICER TELEPHONE EXTENSION

25X1 DDI/NPIC/P&DS/

13. REQUIREMENT/AUTHORITY

R&D project request dated 18 May 1964, approved by DDCI 1 June 1964. This is a joint NPIC/DDS&T R&D program.

14. TYPE OF WORK TO BE DONE

Applied Research

15. CATEGORIES OF EFFORT

MAJOR CATEGORY	SUB-CATEGORIES
Human Factors	

16. END ITEM OR SERVICES FROM THIS CONTRACT/IMPROVEMENT OVER CURRENT SYSTEM, EQUIPMENT, ETC.

Monthly and final reports.

17. SUPPORTING OR RELATED CONTRACTS (Agency & Other)/COORDINATION

CIA/NPIC is currently performing a project which has as its objective the correlation of P.I. performance as related to different ground resolution on photography. This data will be used in the proposed project. DOD has sponsored related projects in the past but with inconclusive results. All pertinent (Contd)

18. DESCRIPTION OF INTELLIGENCE REQUIREMENT AND DETAILED TECHNICAL DESCRIPTION OF PROJECT (Continue on additional page if required)

The photo interpreter is the key element in the reconnaissance exploitation system. Yet he remains the most unknown factor in that system. There are techniques for quantitatively evaluating the hardware and techniques of exploitation but human performance is difficult to account for objectively. In order to refine the total exploitation process, it is necessary to account for, predict, and enhance the photo interpreter's performance.

19. APPROVED BY AND DATE

OFFICE	DEPUTY DIRECTOR	DDCI

FORM 11-64 2338

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(1-13)

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17. agencies are aware of our efforts in this project.

18. The interpreter deals with many variables in his input data. It is the interrelationship of the interpreter with these variables that must be quantitatively evaluated. Among the image variables under consideration are: contrast and brightness, granularity, sun altitude and azimuth, obliquity, scene change detection, color, season, terrain, environment, 25X1 along with [redacted] Also to be studied are procedural variables such as viewing time, scale, the equipment used, and the collateral information available.

In letter MW-M-1313, dated 14 December 1965 (copies of which are available in P&DS) the contractor itemized the labor and materials required to conclude the tasks planned under the existing contract. NPIC's 25X1 working relationship with [redacted] on this contract has been very informal. Since we twice diverted [redacted] from their planned goals 25 in order to accomplish unscheduled, but essential, short-time-period tasks, it seems proper to grant them the funds needed to complete the work currently in progress.

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6 December 1965

25X1 [redacted]

Dear Bob:

We have received the book containing background information on the items used in our study and we are very impressed by 25X1 the fine job [redacted] did in collecting the information and putting it together in a very useful fashion.

The book will be a significant aid in our work. Please convey to Chris our appreciation for a job well done.

With best regards,

[redacted] 25X1

25X1 cc: [redacted]

997/14

25X1 [redacted] 25X1 [redacted]

2 November 1965

25X1 [redacted]

Rome Air Development Center
EMIRC
Griffiss Air Force Base
Rome, New York

Dear Al:

On behalf of all project participants and the sponsor, I want to thank you very much for the cooperation given us in performing the project which was recently completed. The fine job done by [redacted] 25X1
25X1 [redacted] and others contributed a major portion to the success of the project.

I certainly enjoyed working with your group and again, many thanks.

With best regards,

[redacted] 25X1

Research Department

25X1 [redacted]

19 Oct 65

Jim:

Enclosed are 14 pairs of original negatives of pictures we will use in our study.

Please ask your lab to make of each of the 28 pictures:

(a) Three contact paper prints
(b) Three enlargements on paper, approximately 10X.

Please ask the lab staff to handle these O.N.'s with great care since they are very valuable. Also, they should not be shown to or seen by practicing P.I.'s since they will be used in our study. The O.N.'s should be returned to me.

If security labels are necessary, the prints should be stamped "CONFIDENTIAL".

Many thanks,

FS.
Frank

September 28, 1965

Dear Jim:

Enclosed is a stereo pair. The purpose in my sending these to you is to determine if the photographs are mounted suitably for viewing on your equipment. We are planning to mount the GEMS for our study in this fashion; but before mounting all of them, we want to be sure that they are suitable for manipulation on viewing equipment you normally use.

25X1 Would you please ask [redacted] to comment on the way they are mounted?

These pictures are not really GEMS but are contact D.P. from the O.N. Please don't show them to other PI's since this frame is one we selected for the study.

Many thanks,

Frank

mw
Enclosure

25X1

To: [redacted]

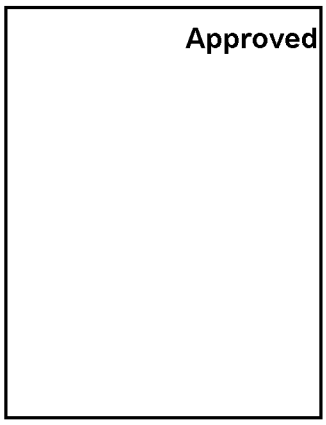
From:

As of 8 October 1965, we have spent 64% of our funds for the P.I. response study.

We anticipate sufficient funds to carry us through May, 1966.

[redacted]

25X1



August 24, 1965

Dear Dick:

I'm not sure if you are still our monitor on this contract but I have sent these to you anyway. Would you make sure that [redacted] gets a copy and ask Frank [redacted] should get one. I'm sorry these are a little late but I forgot to bring them back on my last trip to Washington.

25X1 25X1 25X1

Sincerely,

25X1

AH:lo
Encl: TM 723-1 (10 copies)

THE JUDGMENT OF STEREOSCOPIC DEPTH IN PHOTOGRAPHS AS A FUNCTION OF CONVERGENCE AND OBLIQUITY ANGLES

Technical Memorandum 723-1

Prepared by

[redacted]

July 12, 1965

THE JUDGMENT OF STEREOSCOPIC DEPTH IN PHOTOGRAPHS AS A FUNCTION OF CONVERGENCE AND OBLIQUITY ANGLES

INTRODUCTION

The perception of depth in viewing photographic stereo pairs is often crucially important for making valid interpretations of photographic images. It is known that, within limits, the depth effect experienced by the observer increases as the convergence angle of the camera increases; i.e., as the lateral disparity of the two views of the same object increases. But it is not known how the experience of depth is related to the size of the camera convergence angle or whether the relation is the same for different angles of obliquity--the angle the camera makes with the vertical.

The purpose of this study was to determine, at several angles of obliquity, the relation between the size of the convergence angle and judgment of relative depth.

METHOD

Subjects. The subjects were 10 professional photointerpreters and ranged in experience from 2.5 years to 15 years with a median of approximately 4 years.

Photographs and Viewing Equipment. The photographs were of a scale model which contained a freeway, a freeway overpass, buildings of different heights and shapes, vehicles, foliage, and various terrain features.

The model was photographed at five convergence angles—10°, 15°, 20°, 25°, and 30°—at each of three obliquity angles—0°, 30°, and 60°, making a total of 15 stereo pairs. In addition to the stereo pairs, a non-stereo pair was prepared at each obliquity

angle, making a total of six pairs of photographs at each obliquity angle. The non-stereo pairs were unrealistic in that the sun azimuth was not the same in each half.

The model was illuminated with lights to simulate the sun and the diffuse lighting created by atmosphere. The "sun" azimuth, "sun" elevation (60°), and modulation transfer function were the same for all experimental conditions.

Each photograph was mounted between glass slides. The pairs of photographs were viewed with a Bausch and Lomb stereo-zoom microscope at a magnification set by each photointerpreter.

Procedure. Each photointerpreter made 15 comparisons among six pairs of photographs (5 stereo pairs and 1 non-stereo pair) at each obliquity angle or a total of 45 comparisons.

To control for possible order effects, the 45 pairs to be compared were presented to each photointerpreter in a different random order.

The photointerpreter's task was to answer the question, "Which of the two stereo pairs has the greater relief?"

RESULTS

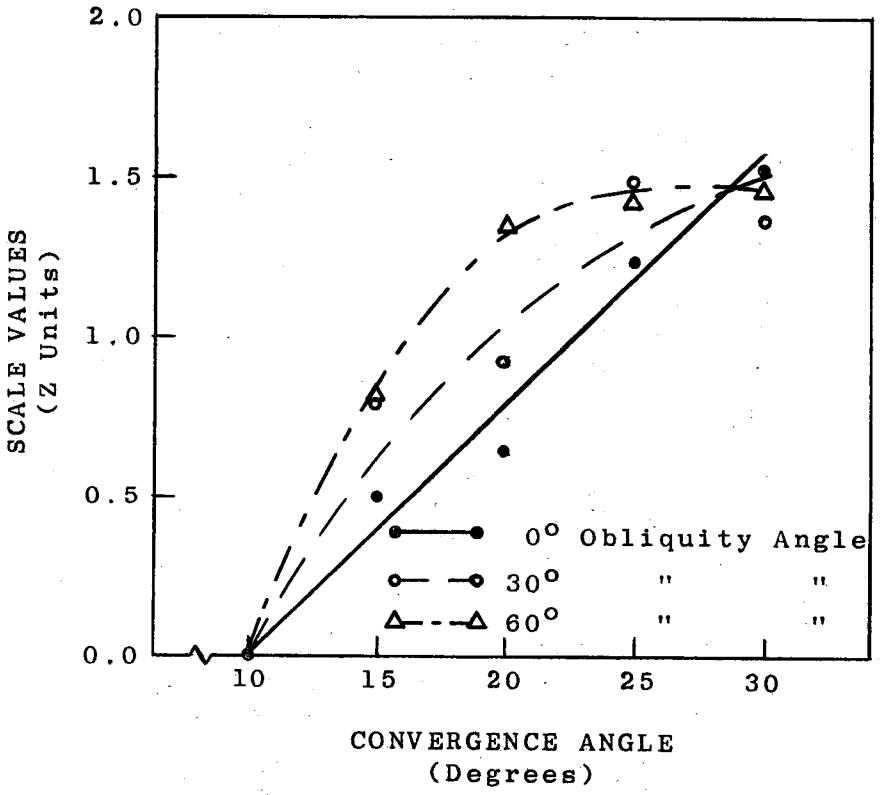
A pair comparison scaling technique* was used to scale convergence angle. Only the comparisons of the stereo pairs (10 comparisons at each obliquity angle) were used to accomplish the scaling.

The proportion of times each stereo-pair was judged as having more depth than another pair was computed. These proportions were transformed to Z scores. (Z's are values of deviates corresponding to areas under the normal curve.) The use of this transformation

*In J. P. Guilford, 2nd ed., Psychometric Methods. New York: McGraw-Hill, 1959, Ch. 7, p. 160.

is based on the assumption that Z values are on a linear psychological scale.

Because the pair-comparison scaling technique does not locate a psychologically meaningful zero point, the origin of each function was set arbitrarily at 0.0 on the ordinate. Consequently only the slopes, but not the heights, of the functions may be compared.



Scale values of convergence angles at each of three angles of obliquity. The functions were fitted visually to the data point.

The results show that at each obliquity angle the scale value (amount of depth seen) increases as the convergence angle increases. At 0° obliquity, the relation between convergence angle and scale value is linear—equal differences in convergence angle produce equal differences in the amount of depth seen. But at 30° and 60° angles of obliquity, the relation is curvilinear and the curvilinearity is greater at a 60° than at a 30° angle. At these two

obliquities, equal differences in convergence angle did not produce equal differences in the amount of depth seen. For example, at a 60° angle of obliquity, a change in convergence angle from 10° to 20° produces a change of about 1.30 scale units, but a change in convergence angle from 20° to 30° produces a change of only about 0.15 scale units—a much smaller change in the amount of depth seen.

Only a small sample of subjects was used in the present study; consequently the functions shown in the figure are not precise. However, the results do seem to indicate that as the angle of obliquity is increased from 0° to 60°, the relation between convergence angle and the amount of depth seen becomes increasingly curvilinear.

Inspection of the judgments made by individual photointerpreters revealed a rather unexpected finding: two of the photointerpreters were apparently unable to see differences in depth. Of the 30 comparisons of the stereo pairs, one photointerpreter made 15 correct judgments and another made 13 correct judgments; chance performance was 15 correct judgments. (A judgment was counted as an error when the stereo pair produced with a smaller convergence angle was judged as having more depth than the one produced with a larger convergence angle.) In addition, of the 15 comparisons of the non-stereo pairs with the stereo pairs, the same two photointerpreters made four and three errors respectively. That is, they judged the non-stereo pairs as having more depth than the stereo pairs. This was particularly surprising since the two halves of the non-stereo pairs did not have the same sun azimuth.

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TID/TAB - 60/65
15 July 1965

MEMORANDUM FOR THE RECORD

SUBJECT: Progress on Human Error Analysis

25X1 **REFERENCE:** TAB Memo [redacted] of 28 June 1965

1. A meeting was requested by [redacted] and held in TAB on 14 July 1965 with the following present: [redacted]
25X1 [redacted] of NPIC.

2. The purpose of the meeting was to accomplish the following:

a. To incorporate recommendations proffered by [redacted] on the design of the simulated targets to be used to establish statistical data on human measuring errors.

b. Review plans for initial feasability study.

c. Establish schedules for completion of project as far
25X1 as the [redacted] inputs are concerned.

25X1 3. Discussions with [redacted] revealed the details on how he intends to make and reproduce the targets required for measurement,
25X1 followed by suggestions by [redacted] on target design, and procedures that would minimize the time spent in measurement.

25X1 4. [redacted] intends to fabricate a few samples of simulated targets in order to determine proper measuring procedures and establish statistical reduction techniques. The targets prepared for the feasability test will be ready for measurement within two weeks. It is anticipated that by mid-September full scale measurements and analysis will commence.

[redacted]
Chief, Technical Analysis Branch

Distribution:
Orig. - Chief, TID/TAB
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25X1 [redacted]:jis

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receipt 3 June 65

To RADC

REQUIREMENTS FOR PHOTOGRAPHY

1. Our project would benefit significantly from the availability of high-altitude (large terrain area coverage) photographs showing whole or large portions of missile site complexes. The photographic quality need not be very good, but just sufficient to determine the site complex layout. These photographs would serve to orient the PI when making a detailed study of a low-altitude high resolution photograph of a particular silo area or support area or control center area, within the complex.

2. The usefulness of the results of our project would be greatly enhanced if a portion (up to one-half) of the photographs of silo areas would show open silos. Thus any effort to photograph open silos or to arrange for the opening of silos is not only worthwhile but very beneficial.

3. Titan II Sites

   3.1 There are no Titan II sites under construction.

   3.2 Primary goal photography of five silo areas, each of which is totally enclosed within a fence, as shown on the attached picture. The control center is also of interest and it also is within the fenced-in area. Photographs of the support area are also desirable; the support area is usually at a USAF base near the complex.

4. Minuteman Sites

   4.1 Photographs of both deployed sites and sites under construction are required: Five deployed sites and a minimum of three (but preferably five) sites under construction.

   4.2 Primary goal of photography are silo areas, control buildings and support areas. The control building usually is fenced-in, and not necessarily near silos.

5. Missile Test Sites

   5.1 Primary goal is photography at two areas: Vandenberg and Cape Kennedy.

   5.2 Vandenberg: Up to three photographs of each of the following: Thor launch pads at N. Vandenburg, Atlas launch pads at Point Arguello, support areas, guidance facilities and propellant plants.

5.3 Cape Kennedy: Suggest you fly along "ICBM Row" to cover Atlas, Titan, Saturn and Saturn V areas, turn around and fly along the "Support Area Row". Of primary interest are big gantries, with and without missiles in position.

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Prepared by: [redacted] 25 June 1965

Copies To: [redacted] 25X1

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cnfs copy.

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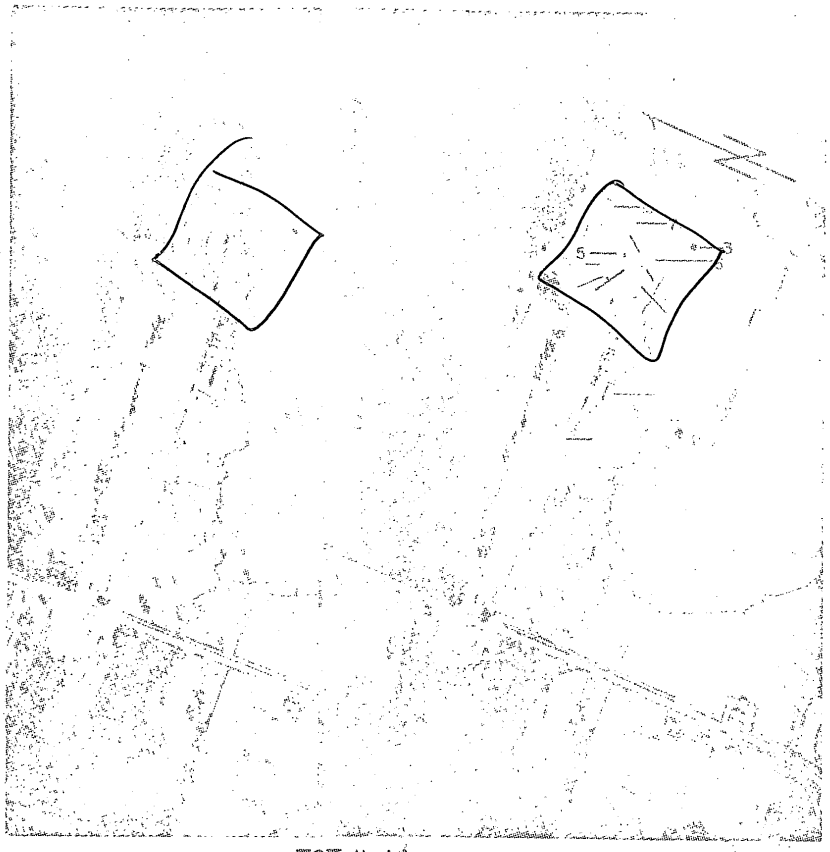

TGT. # 14
TITAN II MISSILE SITE #
4NM SW. OF MARTINVILLE, ARK.
24 NOV. 64
SCALE: 1:7700

SECRET

Approved For Release 2006/02/07 : CIA-RDP78B04770A001800020005-7

SUMMARY MINUTES OF MEETING, 8 JUNE 1965

25X1

PARTICIPANTS: [redacted]

The purpose of this meeting was the verification of the soundness of the proposed mensuration study (which is part of a more comprehensive P.I. performance study) and to incorporate its goals into the similar activities in progress by [redacted] group. The meeting was concluded successfully and the following conclusions and decisions were made:

25X1

1. The experimental study proposed by [redacted] (a) is worthwhile performing, (b) should be conducted with guidance from [redacted] and (c) should be conducted in a fashion such that the results will supplement and conform to the results of [redacted] present work.

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25X1

25X1

2. The experimental effort discussed will attempt to determine mensuration accuracy as a function of several specific image-quality parameters such as spread function size and shape, contrast, granularity and stereo. It was agreed that the experimental procedure which was discussed will yield data beneficial to the prediction of mensuration accuracy of any real material.

3. The study will deal primarily with the human factors associated with mensuration tasks and will not deal with the mathematical (geometry) aspects of photography.

4. Specific details were discussed regarding the preparation of images for mensuration, the procedures and time-consumption of the proposed mensuration tasks, and the project schedule. These details will be described in a description of the project's initial plans being prepared by [redacted]

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25X1

Prepared by: [redacted] 11 June 1965

25X1

Copies to: [redacted]

mb

25X1

file

SECRET

IN 7261

25X1

SECRET 061218Z

[redacted]

YOU ARE AUTHORIZED TO SEND SIX ROLLS TYPE 8430 MATERIAL

25X1 70 MM X 100 FEET UNPERFORATED TO [redacted] FOR MENSURATION

STUDY.

SECRET

-END OF MESSAGE-

ACTION COPY

3

[redacted]

25X1

SECRET

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SECRET

25X1

S E C R E T 011400Z

IN 7129

[redacted]

25X1

PLEASE AUTHORIZE [redacted] TO SEND TO [redacted] SIX ROLLS OF TYPE

8430 DUPLICATING MATERIAL 70MM NON-PERFORATED X 100 FEET

ON ANY CORE OR SPOOL FOR MENSURATION STUDY.

S E C R E T

END OF MESSAGE

ACTION COPY

3

SECRET

[redacted]

GROUP 1
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25X1